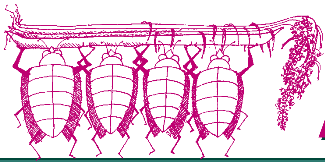
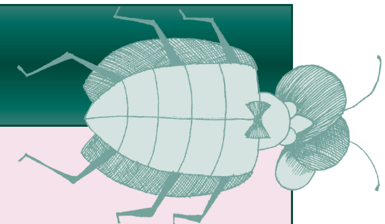


ACTIVITY 11 GRADES 9-12

WETLANDS ON THE MEND



Objectives

➡ Students will apply knowledge/skills gained in Activity 2, "Invasives Exposed!" to data collection with real plants.

➡ Students will explore the connection between biological control and wetland changes.

➡ Students will demonstrate that positive changes in the local environment can result from their efforts.

Time Requirement

At least 3 class periods spread out over the springtime.

Wisconsin Model Environmental Education and Science Standards

Environmental Education: **A.8.2, A.8.4, A.8.5.** ***Science*****: C.8.2, C.12.3, F.12.7, F.12.8, F.8.8.**

B. WOODS

DESCRIPTION

Students generate and compare plant diversity indices from experimental and control mini-wetlands in pots to assess the potential effectiveness of biological control in real wetlands.

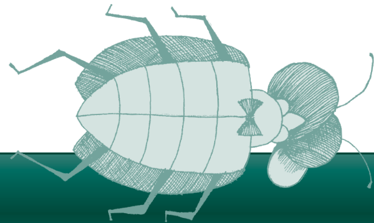
PROBLEM

Can the introduction of biological control insects to purple loosestrife infested wetlands increase wetland diversity?

Note: This activity is designed to accompany active biological control beetle rearing and is built around field placement and retrieval of potted loosestrife plants. Once set up the previous spring, the activity can be done entirely within the classroom the following spring. Materials and set-up are the same as for beetle rearing, except for netted control plants. See the Appendices for detailed beetle rearing instructions and equipment list.

MATERIALS

- ❑ Netting for cage for each pot.
- ❑ Shovel(s) or fork(s).
- ❑ 10-12 inch pots.
- ❑ Potting soil with fertilizer.
- ❑ Duct tape.
- ❑ Pool(s) for pots to sit in.
- ❑ Water source for potting and filling pool.
- ❑ Permanent markers, pens, and plastic flagging.
- ❑ Suspended line over pool.
- ❑ Sunny classroom or school yard space for pool.
- ❑ Purchased or field-collected *Galerucella* beetles, 10 per pot.
- ❑ Aspirator for moving or catching beetles.
- ❑ Copies of student Data Sheet (pages 42-43).
- ❑ Plant identification books.
- ❑ "Do Not Disturb" signs explaining that pots are for school experiment and will be collected.
- ❑ Beans and bags used in Activity 3.



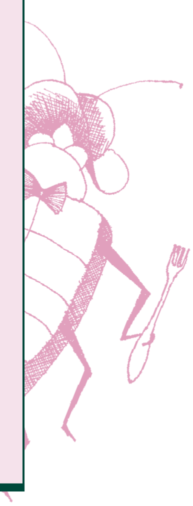
Activity 11. WETLANDS ON THE MEND *(continued)*

B. WOODS

Purple loosestrife plants have extensive root stocks.

PREPARATION
(for teacher or students; to be done annually)

1. Read and discuss the Background Information with students.
2. Sew (or have family or consumer education class sew) netting into cages.
3. Early in spring, dig and pot purple loosestrife rootstocks from a local wetland. (You may want a pair for each team of students, or one "experimental" pot for each team and only one to several "control" pots for the whole class to minimize set-up time. Twelve rootstocks is typical.)
4. Duct tape net cages onto the pots and suspend the cage tops.
5. Label pots "experimental" or "control" and number them. Treat them all the same from now on, except that experimental pots will get beetles and the controls will not.
6. When experimental plant(s) are about 2′ tall, put 10 *Galerucella* beetles onto each.
7. Before release, note the identity and count the number of all plants in each pot. (Count each stem at the ground as an individual plant.) Label each pot and record its number, the date, and all its plant data on a data sheet. (You may have to list only categories of plants to keep identification easy, such as loosestrife, grasses, broadleaf plants, etc., but try to identify as many groups or species as you can. Use made-up names, if necessary, to distinguish different kinds of plants. Tell how this was done for each pot under "Notes".)
8. In the summer, set all plants and pots with nets removed into a purple loosestrife infestation to release your beetles. Flag the plants so that each pot and its plants can be retrieved and evaluated the following spring.
9. Retrieve similar pots put out the previous year, with all contents.
10. Give each student group an experimental pot and either their own control pot or access to class control pot(s), along with the data sheets for these pots from the previous spring.
11. Give student teams a new data sheet for each pair of pots they are to survey.



Activity 11. WETLANDS ON THE MEND

PROCEDURES

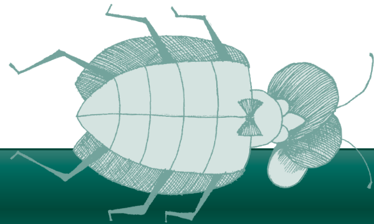
1. Have students keep the pots in a warm, sunny place and watered for up to several weeks to encourage all plants in the pot to grow.
2. Ask students to count the number of **new** loosestrife stems, if any, and, using notes from a pot's data sheet from the previous season, note the identity and number of any other **new** plant stems in the pot in the same manner as before (use same names; see preparation step 7.) Put the new season's data on a new data sheet along with the pot number(s) for easy comparison with the previous season.
3. Have students calculate diversity indices for both experimental and control pots for both years using the data from step one and the data from the previous year. Diversity indices are calculated as discussed in the Background Information and as shown at the bottom of the worksheet (page 42).
4. Ask students to compare/contrast indices for each pot and year and conclude whether plant diversity in any pot has changed and by how much.

PHOTOS: WISCONSIN WETLANDS ASSOCIATION

5. Have students answer the questions posed on the bottom of the worksheet.

BACKGROUND INFORMATION

You have perhaps already learned about biological diversity and at least one simple method for measuring it in a classroom simulation of organisms in a biological community. (See Activity 3, "Bean Biodiversity.") Remember that biological diversity is usually considered to be a measure of how many species there are, as well as their relative numbers or importance in their community. It is a very important concept because a diverse community is thought to be more stable and resistant to degradation, in spite of change around it, than a community with low diversity.



Activity 11. WETLANDS ON THE MEND *(continued)*

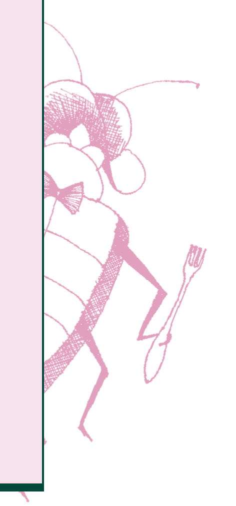
A model can be a great tool to use in understanding such natural processes, though data collected from real organisms is necessary to test the model. Perhaps you have already tried measuring plant diversity in a real wetland or other community as suggested in the extensions for Activity 3. If so, you should have been able to use the model's simple measure of plant diversity directly by recording the species identity of each plant as it was actually encountered along (under) a transect line instead of randomly drawing seeds out of a bag.

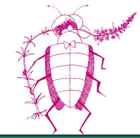
In this activity, you will survey pots of plants that can be considered to represent the larger wetlands from which they came and into which they were placed, treated the same, except subject to either intense experimental beetle predation or none at all (control). You will count how many species of plants are there and their numbers and calculate the pots' plant diversity. Then you should determine the change in diversity in all pots over time, comparing control(s) to experimental pots so you can draw conclusions about what is likely to happen to diversity in wetlands where the purple loosestrife is subjected to similar beetle feeding pressure.

There are a number of ways to calculate the "diversity" in a pot using its plant data. Use each of these three methods in analyzing your data from each pot:

1. Compare the total number of species in each pot as a measure of its diversity. More species are more diverse than fewer. This however does not consider how evenly the numbers of individuals are spread over all the species, an aspect of diversity we already know is important. For example, 10 plants of each 10 species has the same number of species as 91 of one species and 1 of each of another 9, yet the former is considered more diverse than the latter since interactions among the species are more complex.

2. Calculate "Species Richness" (SR), which equals the number of species/the square root of number of individuals. A large "SR" is more diverse than a small "SR," similar to the species number. This measure, however, adds relating species number to number of individuals (since most data are from only small samples of all the plants), giving a better idea of how diverse a set of plants is likely to be. A place where 100 individuals counted results in 10 species (SR = 1) is likely to be more diverse than when it takes 1000 individuals to find 10 species (SR = 0.1). This measure begins to address the "evenness" problem of #1 since fewer individuals should have to be sampled to get 10 species if there are more equal numbers of all the species. Still, in our example from #1 where the number of individuals counted is the same, both sets of plants have equal SRs (1).





Activity 11. WETLANDS ON THE MEND

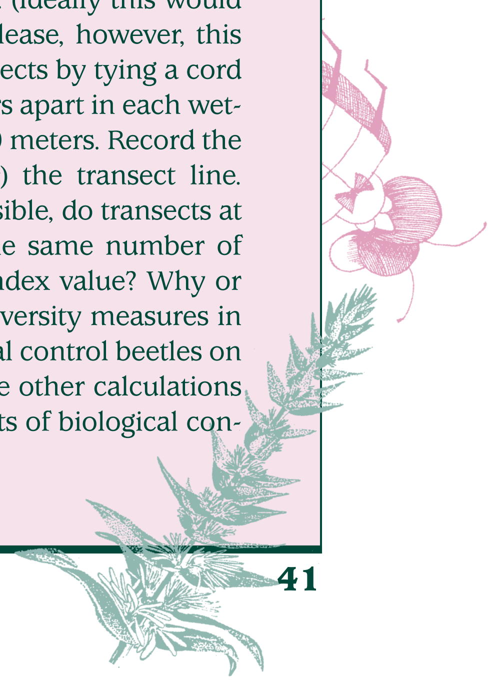
3. Finally, duplicate the Diversity Index (DI) as calculated in Activity 3 (DI = number of runs/number of individuals sampled) by filling a bag with seeds, based on the data from each pot. For example, if a pot has 3 loosestrife stems, its bag will have 3 of one type of seed, representing 3 loosestrife plants. A pot with 3 of each of 5 kinds of plants will have a bag with 3 of each of 5 kinds of seeds. Sample each bag's seeds randomly as in Activity 3 and calculate its DI. The more diverse the set of seeds, the closer to 1 the DI ought to be. Now, number of individuals, evenness, and chance all count. In our example from #1, 10 of each of 10 species should yield a DI much closer to 1 (say, 0.7) than 91 of one type and 1 of each of 9 others (perhaps 0.4). Note also that since chance can always cause any one sample of a bag to give an atypical DI, averaging several sample runs from each bag will give the most accurate results.

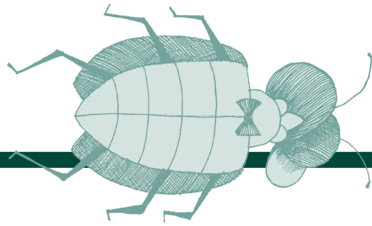
STUDENT ASSESSMENT

Have students write a lab report stating the problem, a hypothesis, experimental procedures, observations, analysis and conclusions. They should include calculations of the diversity measures discussed in the background information and a discussion of what effect biological control insects can have on plant diversity.

EXTENSIONS

Sample real wetlands, with and without the effects of beetles to see if their presence has any effect on plant diversity. Select either two wetlands that were nearly identical at first, one with biological control beetles (for at least two years) and one without, or one wetland with beetle infested and non-beetle infested ends. Try to keep all factors except presence or absence of beetles the same for the two areas sampled. (Ideally this would be done by sampling the same wetland before and after beetle release, however, this requires a study over two to three years or even longer.) Set up transects by tying a cord at least 2 meters up on two posts put into the ground at least 3 meters apart in each wetland area. Transects should ideally be much longer, perhaps up to 30 meters. Record the species identity of each plant as it is encountered along (under) the transect line. Calculate the Diversity Index for the wetlands as in Activity 3. If possible, do transects at several randomly chosen spots in each area, being sure to use the same number of counted individuals each time. Does each transect give the same index value? Why or why not? Average them for a good overall value. After comparing diversity measures in the two types of sites, what can you say about the effects of biological control beetles on the diversity of purple loosestrife and other plants? Apply any of the other calculations of diversity used in this activity to your data to further explore effects of biological control beetles on diversity.





Data Sheet: Plant species and their numbers in experimental and control purple loosestrife pots. (page 1 of 2)

Pot number: ________ **Date data taken:** ________________________

	Experimental Pot # ______ (beetles reared)	**Control Pot #** _______ (no beetles reared on these purple loosestrife plants)
	Plant Species and Number	**Plant Species and Number**
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Diversity Measures:

A. Number of species:____________

B. Number of individuals:__________

C. Species Richness = ___________
(SR = $\sqrt{B}$)

D. Diversity Index = ______________
(DI = # of runs/B)

Diversity Measures:

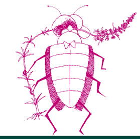
A. Number of species:____________

B. Number of individuals:__________

C. Species Richness = ___________
(SR = $\sqrt{B}$)

D. Diversity Index = ______________
(DI = # of runs/B)

Notes on how plant species or groups were identified:



Data Sheet: Plant species and their numbers in experimental and control purple loosestrife pots. (page 2 of 2)

Questions to answer:

Which plant diversity measure seems best to you? Why?

Was any change in the diversity of the experimental and control pots the same?

In what way did plant diversity in the experimental pot change (if it did)?
Was it truly affected by the beetles? Why or why not?

Based on your data and answers do you think that beetles reared at your school and released into local wetlands will have an effect on plant diversity there? Explain why.

Which type of wetland with loosestrife – one with biological control beetles or one without—do you think is likely to have the greatest animal diversity? Why?